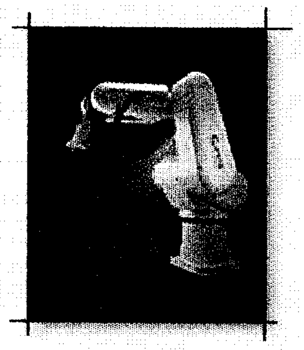
100/100 excellent!

Robotics, CpE 360



Assignment # 4

Submitted to: Prof. Sobh

Ghimire, Bishad
 # 0408455
Oct. 28, 1999

Q #4 .1 Given a desired position of the end effector how many solutions are there to the inverse kinematics of the three link planar arm shown in the fig. If the orientation of the endeffector is also specified how many solutions are there. use geometric approach to find them.

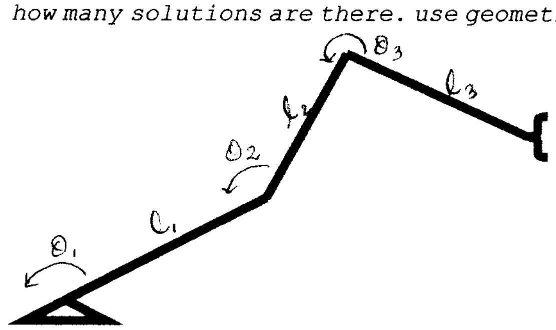


fig. 4.12 Three - link planar robot with revolute joints.

Solution :

The above graphical representation of the manipulator can be derived as follows in terms of workspace and degree of freedom.

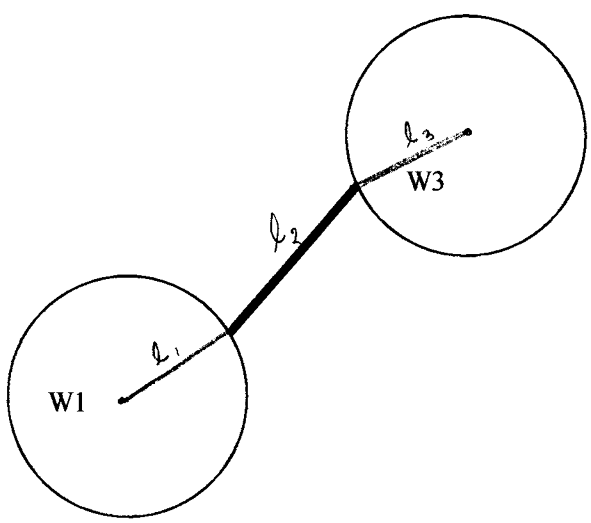


fig. 4.12 Skeleton of three - link planar robot with workspace for its arms.

In this fig above, we can see that the workspace can be defined as W1 for l1 and W3 for l3. This implies that if say W1 and W3 are considered and observed there are infinite number of way that we can relate l1 and l3 through "l2". Similarly for the rest.

Thus it can be simply stated that in the given postion of the end effector there there are infintely many solutions of the inverse kinematics.

Q #4 .2 Repeat #1 for the three planar arm with prismatic joint of fig given.

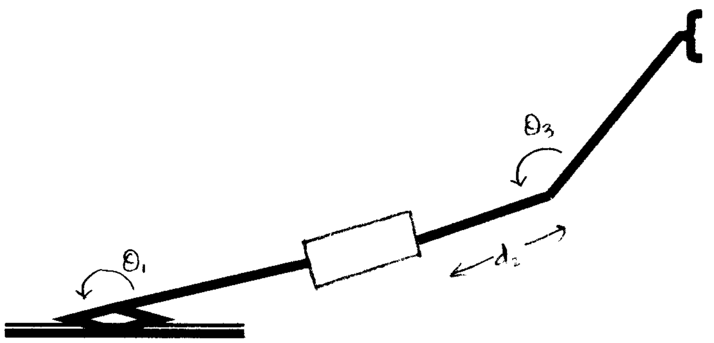


figure 4.13 Three link planar robot with prismatic joint.

Solution :

The above figure can be derived into the following graphical representation :

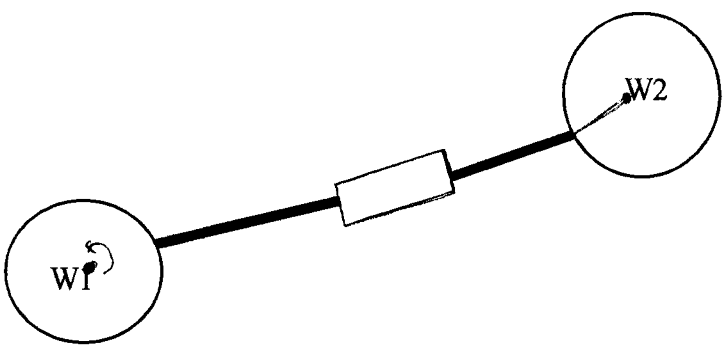


figure 4.13 Skeleton of three link planar robot workspace for its arms.

In this fig above, we can see that the workspace can be defined as W1 and W2. This implies that if say W1 and W3 are considered and observed there are infinite number of way that we can relate them. Similarly for the rest.

Thus it can be simply stated that in the given postion of the end effector there there are infintely many solutions of the inverse kinematics.

Q #4 .3. Solve the inverse position kinematics
for the cylindrical manipulator of fig given below.

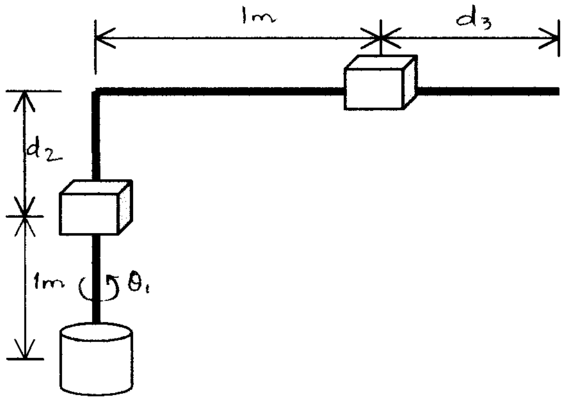


fig 4.14 cylindrical configuration

Solution :

The above fig can be represented geometrical :

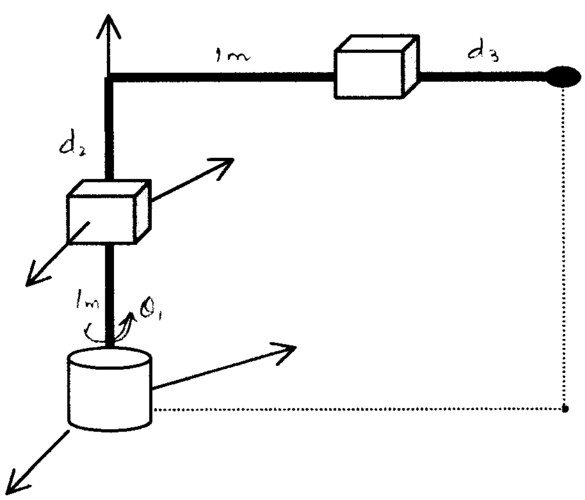


fig 4.14 cylindrical configuration

After the above cylindrical configuration we can resolve the graphical representation into the following i.e.

Now ,

we can see that the
angle = $\tan^{-1}(y/x)$

similarly,

$d2 = z - 1\,m$ **and** $d3 = l\,(ef) - 1\,m = \sqrt{x^2 + y^2}$

Q #4 .4 Solve the inverse postition kinematics for the cartesian manipulator of fig given.

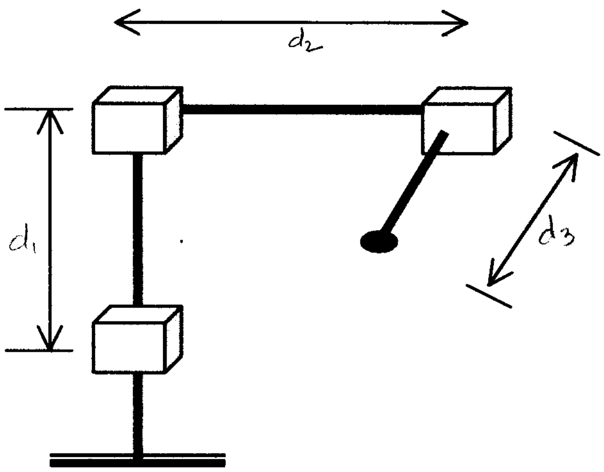


fig. 4.15

Soltion :

After the decomposition of the above implemented representation we get,

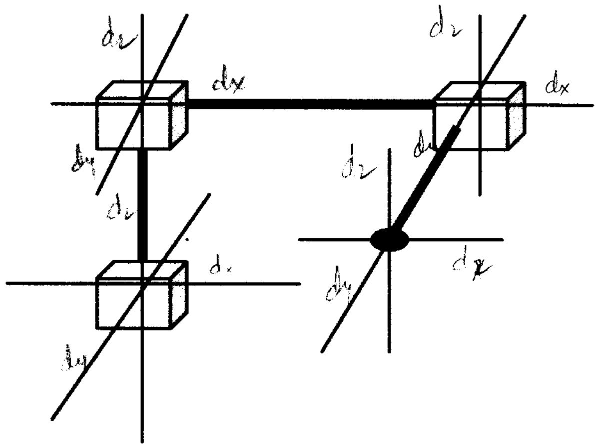


fig 4.15 Skeleton with the corresponding axis

```
<< LinearAlgebra`MatrixManipulation`
```

```
d = {{d1}, {d2}, {d3}}; MatrixForm[d]
```

$$\begin{pmatrix} d3 \\ d2 \\ d1 \end{pmatrix}$$

but we can expressed it as

```
d = {{d1}, {d2}, {d3}}; MatrixForm[d]
```

$$\begin{pmatrix} d3 \\ d2 \\ d1 \end{pmatrix}$$

```
d˜ = {{dx}, {dy}, {dz}}; MatrixForm[d˜]
```

$$\begin{pmatrix} dx \\ dy \\ dz \end{pmatrix}$$

and is d = d˜

$$\begin{pmatrix} dx \\ dy \\ dz \end{pmatrix} = \begin{pmatrix} d3 \\ d2 \\ d1 \end{pmatrix}$$

Thus the inverse kinematics has been shown as above.
